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BARK BEETLE PROBLEMS IN CALIFORNIA'S TIMBER

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THE THREAT

Insects are among the most important hazards in growing a timber crop to harvest size in our California forest areas. Fewer than a half dozen species cause the greatest concern, and only three are responsible for nearly 70 percent of the total damage done each year. The killing in pine alone caused by bark beetles in a normal or endemic year ranges from 200 to 500 million board feet an amount which, if sawn into lumber, would provide housing for a city appreciably larger than Fresno. Past epidemics have resulted in the killing of nearly 10 times this amount of timber in a single year.

MOST SERIOUS KILLERS

Listed in order of importance and the timber species affected, these are the bark beetles which do the most killing. Except for the 5-spined engraver beetle, all species infest the main lower and mid-bole portions of the tree. The 5-spined engraver infests the top portion of the main stem and larger limbs, and also kills pole-size trees and reproduction.

Common Name	Scientific Name	Host Trees
Western Pine Beetle	Dendroctonus brevicomis	Ponderosa Pine Coulter "
Mountain Pine Beetle	Dendroctonus monticolae	Sugar Pine Howitzer [illegible] Lodgepole Pine Ponderosa Pine White Bark Pine
Jeffrey Pine Beetle	Dendroctonus jeffreyi	Jeffrey Pine
Douglas Fir Beetle	Dendroctonus pseudotsugae	Douglas Fir
5-Spined Engraver Beetle	Ips confusus	Ponderosa Pine Sugar Pine Coulter Pine Monterey Pine Knobcone Pine
Fir Engraver Beetle	Scolytus ventralis	White Fir Red Fir

HOW THEY KILL

In their attack upon living trees bark-beetle habits are similar. Attacks are initiated by adults which bore through the outer bark to the inner bark or phloem, lying just outside the wood. Within the phloem layer they excavate egg tunnels, the length and pattern of which are characteristic of a given species. In all cases the sapwood surface is grooved or lightly marked by the egg galleries, resulting in destruction of the cambium layer. Successful killing by a given bark-beetle species depends on the concerted invasion of many adults, numbering from 10 to 50 per square foot of inner bark surface. Once an attack is initiated, boring is continuous unless beset by temperatures forcing dormancy, for periods from 4 to 8 weeks or longer. All species undergo complete metamorphosis during a life cycle; i.e., they pass through egg larva, pupa, and adult stages. The number of successful progeny produced varies, but is usually 3 to 4 times the number of attacking parents, and often exceeds 10 times the number of parents.

NUMBER OF GENERATIONS

Each bark-beetle species produces one or more generations per year, as tabulated below.

Bark Beetle	Number of Generations	Over-winter Stages
Western Pine Beetle	3	Adults, larvae
Mountain Pine Beetle	2	" "
Jeffrey Pine Beetle	1	" "
Douglas Fir Beetle	1	" "
5-Spined Engraver Beetle	4	" "
Fir Engraver Beetle	1	Larva

In general, every generation produced means the sacrifice of more trees in the forest. Only the living trees are sought out, since they serve as the food supply upon which the adult beetles must feed and rear their young. Dead trees are no longer suitable for bark-beetle food.

RECOGNIZING AFFECTED TREES

Attacked trees can be recognized, even before symptoms of dying set in, by borings and pitch tube formations that occur in numbers in the bark crevices of the trunk. The most positive dying symptom is a sudden change in foliage color from the normal green. At first the crown turns yellowish, fading rapidly through straw color toward reddish brown, making the affected tree conspicuous for a considerable distance. Freshly-fading trees seen during the summer and fall contain the maturing broods of bark beetles, and they are abandoned within 2 to 3 weeks or less. Freshly-fading trees in early spring are not ordinarily abandoned for a period of one month to 6 weeks because of cool air temperatures which retard activity at that time.

ASSOCIATED INSECTS

Dead trees abandoned by bark beetles serve as food and shelter for many different species of secondary insects, among which round-head and flathead

borers are largest in size. A great host of different species of bark beetle borers, ants, and termites come into dead trees at different stages of deterioration, and in fact hasten decomposition, but none of them are of economic concern as tree killers. It is therefore of interest to the layman to understand that insects in and about dead and deteriorating trees are not tree killers.

NATURAL CONTROL FACTORS

Bark beetles are controlled in nature by a number of different predatory and parasitic insect enemies, and while they help a great deal, all of them combined are incapable of preventing destructive outbreaks. Insect predators and parasites greatly outnumber other forms, among which only a few species are outstanding. Among the birds several species of woodpeckers do an effective job in helping to reduce populations. Some control is accomplished by rodents. Despite these known natural agencies of control and many others among the fungi, nematodes, and bacteria, periodic outbreaks and the necessity of artificial control measures.

RECOGNIZING OUTBREAKS

Bark-beetle outbreaks are recognized by the occurrence of an unusual number of trees killed in one season within a great area, as single trees or small sized groups. Through periodic surveys experienced forest entomologists detect outbreaks at their beginning, and recommend the plan and extent of suppression effort that should be undertaken.

HOW BARK BEETLES ARE CONTROLLED

In general, there are two approaches to the control of an infestation: (1) indirect or silvicultural approach; (2) the direct suppression of beetle populations. The indirect approach is the more desirable both economically and as a preventative, but at present because of much needed research is limited to specific climatic zones where results have shown their worth. The direct approach is still necessary to suppress most outbreaks, but its application is costly. Each method is described briefly.

Remove susceptible trees

Indirect control is applicable at present only to control western pine beetle infestations in ponderosa pine east of the Sierra-Cascade divide. In this method external tree characteristics or symptoms are recognized which indicate degree of susceptibility to attacks; trees are classified into one of 4 different degrees of risk, and the higher risk element is removed through logging and sawn into lumber. Experience has shown that the removal of the susceptible element of a pine stand greatly reduces the chances of an outbreak. Its value is proven in the fact that a wide segment of the lumber industry is sold on its benefits which, in addition to controlling outbreaks, secures full utilization of timber resources.

Kill populations

Direct suppression methods are used primarily in the control of the western pine beetle in westside ponderosa pine areas, those areas lying west of the

Sierra-Cascade divide, the mountain pine beetle in sugar pine, lodgepole pine, ponderosa pine, and mountain white pine, and the Jeffrey pine beetle in Jeffrey pine. In this approach effort is directed at reducing beetle populations by destroying them through any one of several methods: (1) by felling, peeling, and burning the bark of infested trees; (2) by felling and spraying the infested bark with toxic oil sprays; (3) by felling and exposing infested bark to solar radiation; (4) by salvage logging to mark and remove infested trees from timbered areas before beetles emerge. Some of the more important factors which govern the method to be employed depend on bark thickness and texture, air temperature, fire hazard, topography, etc. Even so, considerable experience and judgment are essential to determine the best method to be employed at the time direct control becomes necessary.

Discourage Breeding

Spring and early summer slash from logging or clearing in ponderosa pine in partial or full shade serves as ideal breeding material for the five-spined engraver beetle. Except for greatly weakened and dying trees, slash consisting principally of tree tops, serves as the only source in which successful broods can be established in spring and early summer. Living trees become more susceptible to attacks after mid-summer, and in some years great numbers of them are killed by adults emerging from the earlier slash.

Prevention of breeding in the early season slash by lopping limbs from tops and scattering them to allow the penetration of solar heat, greatly reduces breeding. The changing of logging or clearing schedules from early season (April to July) to late season (August to November) also greatly lessens the breeding hazard, and is encouraged where possible.

RESEARCH NEEDS

The indirect control approach of bark beetles in westside pine stands is a most desirable objective, but its application must await considerable investigative study. Only a beginning has been made in developing theories on the basic causes underlying outbreaks, but until they have been tested and proven, no large scale action can be taken. It is hoped that stands of timber may eventually be managed through thinning and improvement practices to such an extent that the general health and vigor of these stands will discourage all bark-beetle invasions.